DART4
CITY

Dart4City

Teacher's Handbook

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CEU Universidad Cardenal Herrera

HERON Digital Education & Mathisis.org

ALTEREVO SOCIETÀ BENEFIT

Fondazione Štěpán Zavřel

DART 4CITY

THE PROJECT

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DEVELOPING AND IMPROVING ART AND CREATIVITY FOR THE CITIES OF TOMORROW

The Project Dart4City "Developing and improving Arts and creativity for the cities of tomorrow" arises from the idea of connecting the existing curricula in scholar education, and the need to provide students with skills related to creativity and innovation, since these competencies are highly required in the societies of the future to address challenges such as environmental issues (climate change, energy provision, waste management, etc), social inclusion, citizen participation and engagement, inclusion and management of innovation, among others (European Commision, 2019).

Some indicators of these skills are fluency to produce ideas and associations; the flexibility to generate ideas and solutions to a given problem or challenge; and originality to generate ideas that are less habitual.

It is often overlooked in STEAM projects that a key point of the plan is precisely the promotion of language arts and social sciences (Yackman, 2012), that set STEAM learning between STEM and holistic learning. and constitutes the agent that allows the connection between the different sciences. Moreover, there are not enough studies and methodologies that allow a deep analysis of educational laws, the detection of opportunity areas and the development of frameworks and teaching strategies and planning in STEAM projects in an effective way, including evaluation standards and methods.

This way, DART4CITY aims to provide tools and resources to teachers and professionals in the field of education, as well as decision-makers and other stakeholders (families and NGOs) to translate the existing education normative into STEAM projects (Ruiz Vicente, 2017; Ruiz Vicente, 2019).

To this end, the project uses the STEAM learning model to address this challenge, through the integration of arts (A) with the other scientific-technical disciplines: science (S), technology (T), engineering (E) and mathematics (M).

In summary, the GENERAL OBJECTIVE of DART4CITY is to develop and to validate a methodology for the full integration of Arts and Creativity in primary and secondary school curricula in Europe, as part of STEAM teaching approaches, regarding contents, evaluation criteria, learning standards and methodological recommendations, so they are organized in a global and interdisciplinary way; and to disseminate the proposed methodology at the European level, taking into account the different national backgrounds.

1. INTRODUCTION

The social and technological changes of the 21st century pose the need to redefine the teaching model so that the development of skills related to creativity and innovation is linked to the acquisition of scientific-technical skills and therefore today's students will be able to solve the uncertain challenges of the future.

STEAM learning is one of the models seeking to respond to this challenge by integrating art (A) with the other scientific-technical disciplines: Science (S), Technology (T), Engineering (E) and Mathematics (M). Within the unpredictability of the future, what labour market trends do specify is that technological knowledge will be essential for 80 % of workers and the qualifications necessary to enter the labour market will be measured by technological competences (European Centre for the Development of Vocational Training CEDEFOP, (2011)). According to this forecast there is an emerging need to train newgenerations whose STEAM skills are sufficiently developed to know how to adapt and develop technologies yet to be discovered.

The STEAM learning is an educational model that pursues the integration and development of scientific-technical and artistic subjects in a single interdisciplinary framework (Yakman, (2008). The acronym arises in 2008 whenYakman, trying to foster interdisciplinarity, introduces the A from "Arts" into another existing acronym that collected the English initials of the disciplines of Science (S), Technology (T), Engineering (E) and Mathematics (M). In 2008, Yakman's essay states that, assuming the need to opt for an integrating concept of STEM learning, it is essential to introduce in the model what in English is called "the arts" in order to generate a truly integrated and creative learning (Yakman, (2008). The idea of "the arts" introduced by (Yakman, (2008) is a very broad concept that covers fields such as language arts, social sciences and physical arts in addition to those traditionally considered to be fine arts. Thus, with their integration into STEM learning, "the arts" become a multidisciplinary agent that connects the sciences with artistic fields which facilitate communication, the understanding of reality and bring out creative strategies and solutions (Yakman & Lee, (2012)).

When the Pisa report (OECD, (2007)) revealed the low level of knowledge, interest and motivation of South Korean students, the Korean government, looking at the educational trends of the moment, but especially taking into account the US contributions, devised an education plan based on STEAM learning Yakman became their adviser and taking into account her theoretical framework(Yakman, (2008)), a national proposal based on STEAM learning has been developed. This national plan is one of the most used references in the scientific literature to support the viability of STEAM learning, although it is not necessary to overlook that a key point of the plan is the promotion of language arts and social science.

One of the institutions that has disseminated and enhanced STEAM learning most is the Rode Island School of Design (RISD) and its informative initiative, "http://stemtosteam.org", which is one of the best-known initiatives regarding this field. The STEAM framework defined by the RISD changes substantially from Yakman's model by the way in which art is incorporated to the rest of the disciplines, by equating it to the design and giving it a strong innovative character. The RISD defines the goal of STEAM learning as a transformation of research policy in order to place art understood as design at the centre of STEM learning. From this point of view, the artist-designer has much to say in the processes of scientific-technological development and must be present in every innovation team. The RISD poses the challenge of placing arts education as a discipline fully integrated in the scientific learning of primary and secondary education. By combining art and creativity with other disciplines, aspects such as innovation and design, the development of curiosity and imagination or the search for diverse solutions to a single problem are valued.

Within the STEM field, (Yakman, (2008), showed that the need for a certain degree of curricular integration and interdisciplinary learning had already been raised individually within each of the disciplines. This review also allowed her to classify what is specific to each discipline, what makes it unique and the difference from the rest of STEM fields and discover that art (A) provided an extra component of interdisciplinarity and creativity. These definitions are included below starting with the STEM areas and leaving art (A) for the end.

DART4 CITY

2. DART CITY PROJECT

Moreover, the project has the following SPECIFIC OBJECTIVES:

1	To analyze the curriculums from different countries using the novel methodology proposed in our previous works and determine the opportunity areas to integrate arts and design in STEAM projects.
2	Develop and test STEAM projects in real environments, based on the opportunity areas detected in each country based on cooperative puzzles and including new learning methodologies that promote the skills associated to creativity and arts, such as lateral thinking, communication, participation and engagement.
3	To promote the adaption of educational systems to current societal challenges, mainly regarding sustainable development, that requires competencies associated with creativity, design and innovation.
4	To promote the social inclusion of students by fostering participatory approaches and intercultural dialogue in education.
5	Improving the skills of trainers and educators, providing them with tools and resources to achieve the above objectives.
6	Contacting decision-makers in the field of education, to improve the education laws and the existing curricula.

The need to carry out this project transnationally lies on the different educational curricula that can be found in the European countries. This way, the cooperation of partners from different fields and educational backgrounds, including formal, informal and non-formal education, that share the main objective will provide an exchange of ideas which is crucial for obtaining successful and practical results, as well as for ensuring that the obtained outputs are suitable to contrasting national backgrounds and transferable to other realities.

Therefore, linking the project to a European network with specialized experts will provide value to continue spreading the work done and foster the opportunities for dialogue and collaboration.

3. PARTNERS

CEU GROUP · *Spain*

CEU Group is the biggest and most traditional educational institution in Spain. It comprises 25 educational centers, including one university with 3 campuses in Madrid, Valencia and Barcelona and ten schools, in addition to other professional teaching centers, ranging from Children´s education to Postgraduate studies and Professional Education.

Today, about 31,000 students are taught in CEU classrooms, in addition to more than 100,000 professionals who have studied at this institution in the past. In the present project participates the University CEU Cardenal Herrera and the Schools that the CEU GROUP has in Spain CEU Cardenal Herrera University (FSP-CEU), is located in Valencia and has three campuses, Castellon, Valencia and Elche.

The goal is to guarantee the initial and continuous training of graduates, postgraduates and doctors in the scientific, technological and economic fields, as well as in the social and human sciences, to guide fundamental and applied research activities in the scientific and technical fields. FSP-CEU has several faculties but the present project involves two of them, the faculty of Humanities (educational branch) with bachelor and masters degrees related to education at different levels and the ESET, founded in 1987 by the CEU Foundation as a technical school for industry workers, being its study programs in architecture, design and engineering officially recognized by the Spanish Government.

CEU Group has ten Schools in Spain, Claudio Coello, Monteprincipe, Sanchinarro, Murcia, Jesus Maria Alicante, Loreto-Abat Oliva, Cardenal Spínola-Abat Oliba, CEU Virgen niña, Valencia y Sevilla. The schools has a student-centred model where students are accompanied from the early years and afforded a wealth of experience in learning, values, collaboration and internationalization that help them to build a complete and balanced identity.

In the present project the schools tested the STEAM projects proposed by the CEU GROUP team.

HERON · *Cyprus*

Heron is a non-profit research organization, founded by the Mathisis.org team of teachers who operate in Greece and Cyprus since 2006, and officially became a legal entity in 2018.

Heron develops digital educational content, organizes teacher and parent trainings and events, such as the acclaimed First Lego League (Athens, Greece) and First Lego League Jr (Nicosia, Cyprus) robotics competitions. Heron is also responsible for the educational content and workshops curriculum for the first Cyprus Computer History Museum.

Mathisis.org group, founders of Heron, have pioneered the introduction of 1-1 computing in Cyprus and Greece through the support and deployment of the One Laptop Per Child initiative, various tablet projects as well as Learning Management System integration in Primary Education.

Currently, Heron is promoting the inclusion and equal representation of girls in robotics and engineering projects, as well as developing content for the Computer History Museum to promote the role of women in computer science, with such prominent scientists as Lady Augusta, Margaret Hamilton, Grace Hopper and others. It is also involved in an Erasmus+ KA2 project in the development of tools and material on gender-based violence.

ALTEREVO · *(Italy)*

Alterevo is a consultancy constituted in 2018 by a group of senior professionals active in the field of strategic development through creativity and innovation, both for public and private institutions. It was created to contribute to sustainable, concerted and innovative Territorial Development through the dissemination of the culture of project design and impact assessment.

While Innovation and Development are terms that recall complex references and require the analysis and continuous in-depth study of multiple scientific, technological, regulatory and managerial aspects, only an integrated and multidisciplinary approach allows to deal with this complexity and to consider and integrate social and economic assessments in order to achieve effective, innovative, solid, shareable and above all sustainable solutions.

Alterevo main fields of expertise are creative and social innovation projects: it provides a team of experts with different backgrounds able to understand and interpret the development and innovation needs of Institutions, Organizations, Associations and Companies, enhancing them through co-generative and collaborative approaches and crossing them with the main existing funding lines, not only at local, regional or national level but also and above all at EU level.

In fact Alterevo, thanks to the experience of its components, collaborate with a very extensive regional, national and above all international networks useful for building partnerships with a propensity to innovation.

The company offers a wide range of services for the development of growth and innovation strategies of its clients:

1 *STRATEGIC PROJECT DESIGN*

Alterevo is specialized in multi-stakeholder and multi-level programming actions aimed at Sustainable Territorial Development, through the development of cultural and innovative projects.

2 *MANAGEMENT OF PARTICIPATORY PROCESSES (I.E. FACILITATION)*

Alterevo support decision making processes of groups of interest and the generation of specific product or services through the experiences, knowledge and interactions of the group members themselves, starting from a shared need/problem. Alterevo believes in participatory, shared, plural and inclusive approaches.

3 *TRAINING*

Alterevo senior components develop ad-hoc training paths in the sector of strategic project development and assessment, social innovation and creativity, working in collaboration with national and international training centers and Universities.

4 *IMPACT EVALUATION*

Thanks to the collaboration with international partners and senior professionals, Alterevo provides social impact evaluation and assessment of projects and activities, developing tailor-made tools and approaches.

5 *URBAN REGENERATION*

Alterevo applies multi-professional approaches to spaces, places, buildings, focusing on the elaboration of a Management Plan able to move from a shared vision to sustainability overtime of the installed activities. Architectural and urban planning aspects must coexist with economic, environmental and social impact analyses, as well as the involvement of institutions and the community as a whole.

ŠTĚPÁN ZAVŘEL FOUNDATION · *(Italy)*

The Štěpán Zavřel Foundation is like a slender yet strong silk thread connecting Sàrmede to the rest of the world. Thanks to its work, every year this corner of Italy becomes a fantastical place, where imagination is a right to be exercised, taught, and learned.

The idea of setting up the Exhibition was conceived in 1982 by Štěpán Zavřel, a renowned illustrator from Prague who later moved to Rugolo in Sàrmede (Province of Treviso). Since then, spurred on by ever-increasing success and the invaluable help of many artists, the Exhibition has shown over 300 works of art from countries all over the world to its numerous visitors each year, taking them on a fabulous journey through the fanciful imagination of each country.

The foundation is the result of Zavřel 's dreams, and of his desire to transform Sàrmede's creative experience into a legacy for the future, focusing on the artistic and educational value of the illustrated book. Two little plants have sprouted from this seed: the exhibition and the school. Both have their roots in a dream and both are growing through the years, turning the little corner of the world where they first blossomed into a continuous source of creativity, imagination, and collective learning.

So the Foundation's aim is to use the capacity of art and culture to enhance the creativity of the youths.

4. METODOLOGY

The methodology proposed as a result of the DART4City project analysed the national curricula of the partner countries such as Cyprus, Italy and Spain, as well as the vast majority of curricula of other European countries. The methodology has a first stage in which the curriculum is analysed to extract the thematic areas of the curriculum and subsequently two variants will emerge: "forward" and "backward", see Figure 1.

- Regarding the "forward" variant, the main theme of the STEAM project is based on one of the areas of opportunity obtained from the thematic areas with the highest number of connections with the other thematic areas; in this way, the areas of opportunity are the areas that will cover a greater amount of content.
- Concerning the "backward" variant, we start from an idea or concept that will be the main theme of the STEAM project and then we go back to look for the thematic areas of the curriculum that are related to the selected theme.

COMMON STAGE TO THE TWO VARIANTS

The first step for the application of both variants is to choose the course, the courses or the stage, in which the STEAM project will be developed. Once the recipients have been selected, the initial analysis of the curriculum begins in order to obtain the thematic areas that will consist of four phases:

PHASE 1. *Item filtering* (vertical redundancy)

In this phase the redundant items are searched in the curricula of the analysed courses, understanding that two items are redundant if they appear written exactly the same in two courses at least. In this phase, the redundancy index is also defined as the relationship between the number of vertically redundant items and the amount of initial items in the EU education law.

PHASE 2. *Formation of curricular groups*

In this phase, items with similar content are gathered in curricular groups. Two items have similar contents if, within the same subject, they refer to the same concept, but focused from different learning perspectives.

PHASE 3. *Classification of curricular groups in STEAM disciplines*

The objective of this phase is unlinking the curricular groups from their subject of origin in order to classify them within one of the STEAM fields or disciplines. The classification of each curricular group within one area or another was carried out according to the definitions made by (Yakman, (2008), for Science, Technology, Engineering and Mathematics and the Art definition made by the Rhode Island School of Design.

PHASE 4. *Obtaining thematic areas*

In this phase, the curricular groups of each STEAM discipline are reorganized, forming the thematic areas of each discipline. In this way, the thematic areas of each discipline bring together the curricular groups with content related to each other.

The implementation of the first two phases depends on the drafting of the curriculum of each country and the level of concreteness of the contents of each subject. For example, while the Spanish curriculum is written with a very high level of detail and exactly the same items appear in different courses, in the Cypriot curriculum the items are not repeated and are presented in curricular groups in each subject.

Once the curricular groups have been obtained, the STEAM classification is carried out in phase 3, in which two types of curricular groups are differentiated: conceptual and non-conceptual or procedural.

1. The conceptual curricular groups are the ones directly related to the contents, they answer the question: ***what are we going to learn?***
2. Non-conceptual, or procedural, curriculum groups are those groups related to the learning process that are not specific to any STEAM discipline. They usually answer the question: *how are we going to learn?* In this type, curricular groups are classified as "autonomous and cooperative learning", "recognition of the work of others".

In phase 4, the thematic areas are also classified as conceptual and non-conceptual, or procedural, depending on whether they consist exclusively of conceptual or non-conceptual curricular groups.

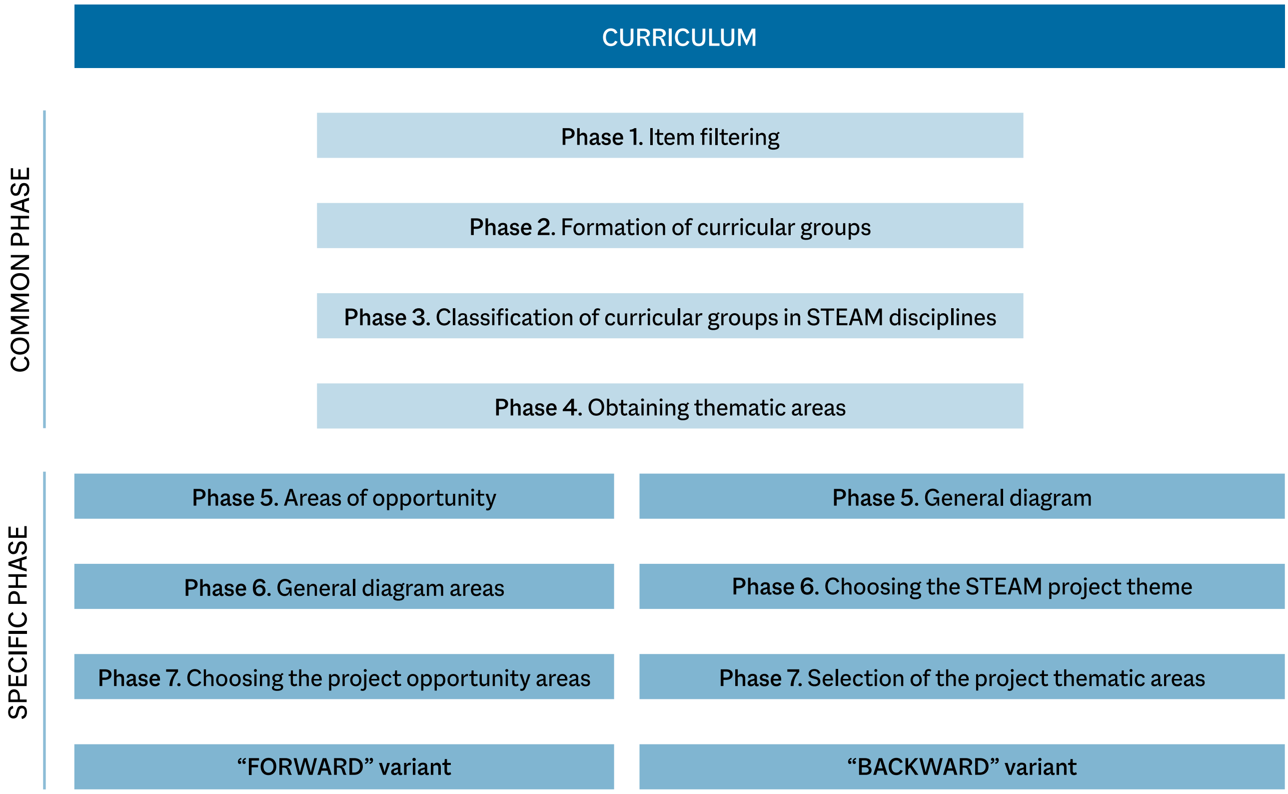

Figure 1. *Diagram of the methodology for developing STEAM projects from the curricula*

METHODOLOGY OF “FORWARD” VARIANT

The objective of this stage of the “forward” variant is to obtain the opportunity areas of STEAM projects, which can also be conceptual and non-conceptual, or procedural. An area of conceptual opportunity is defined as a thematic area belonging to a STEAM discipline that meets the necessary conditions to be the main theme of a STEAM learning project, so an area of opportunity must meet the characteristics of the challenge or challenging question of the project-based learning and the characteristics of the generative topic of teaching for understanding.

From this perspective, an area of opportunity:

- Stands out for its centrality and breadth within the discipline.
- Must be close to the students, connected to their reality, accessible to them and open and motivating enough to promote the whole project.
- Its study should allow to establish intra and interdisciplinary connections, that is, to relate with other areas within the discipline itself and with areas of other STEAM disciplines.

Non-conceptual areas of opportunity are made up of attitudinal and/or procedural contents. The contents of these areas of opportunity do not represent contents close to the students and are far from their daily reality, so it is considered that they cannot motivate and trigger a STEAM project, although their inclusion in STEAM projects is important. This stage consists of three phases:

PHASE 5. *Map of intra-disciplinary relationships and selection of areas of opportunity*:

In this phase the redundant items are searched in the curricula of the analysed courses, understanding that two items are redundant if they appear written exactly the same in two courses at least. In this phase, the redundancy index is also defined as the relationship between the number of vertically redundant items and the amount of initial items in the EU education law.

PHASE 6. *Preparation of the general diagram:*

A general diagram is generated taking into account all the thematic areas: both areas of opportunity, conceptual and non-conceptual, and non-opportunity areas that will allow to relate all the areas to each other, see Figure 2.

The first step for the application of both variants is to choose the course, the courses or the stage, in which the STEAM project will be developed, once the recipients have been selected.

The diagram is divided into 5 sectors and three concentric circles. The sectors correspond to each of the STEAM disciplines and the areas of each discipline are placed in the concentric circles of each sector and therefore:

- The non-opportunity thematic areas are placed in the outer circle, that is, they do not have enough connections to trigger the STEAM project.
- Conceptual opportunity areas that do have a high number of connections are placed in the intermediate circle and they can therefore become the main theme of the STEAM project.
- The non-conceptual or procedural areas are placed in the inner circle.

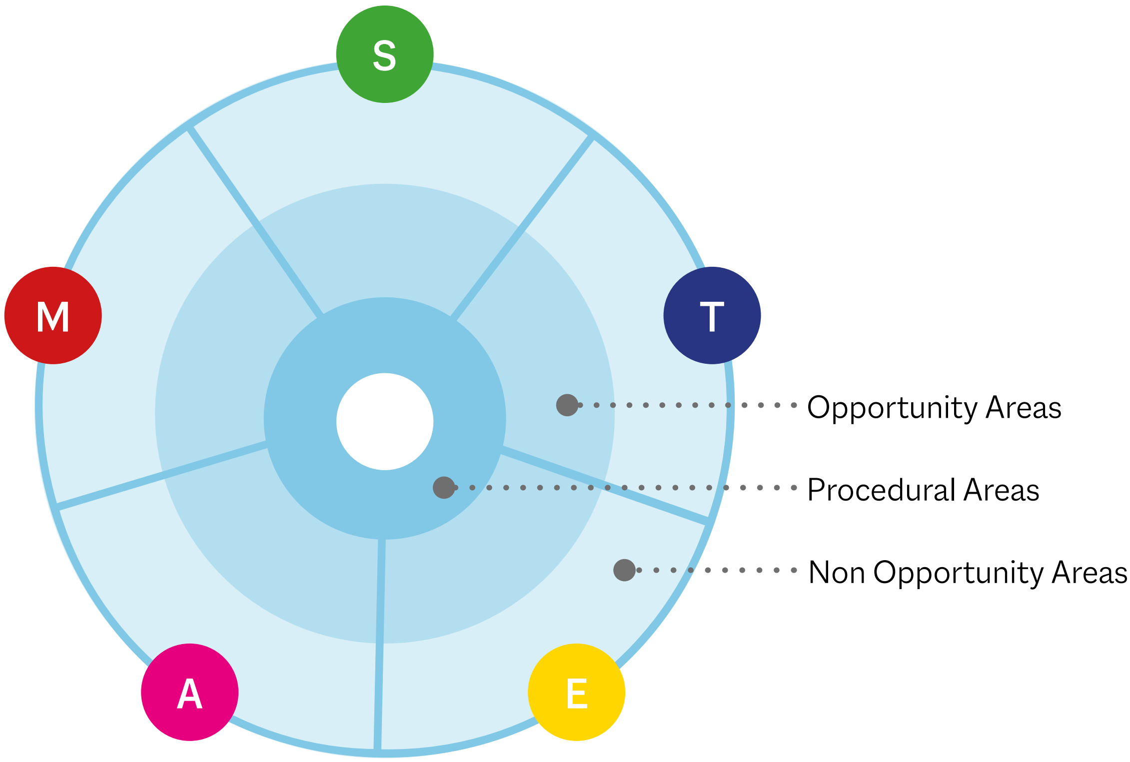

Figure 2. *General diagram of "forward" methodology areas*

PHASE 7. *Choice of the area of opportunity and development of the STEAM project*

In this phase, the area of opportunity is chosen, which will be the main topic on which the STEAM project will be developed, which, in order to be complete, must contain areas of each of the STEAM disciplines and, if possible, all the procedural areas of the inner diagram. This is a creative process in which countless STEAM projects can be developed for the same area of opportunity, being the teacher responsible for defining the theme of the project, its planning, its development, the use of active methodologies.

METHODOLOGY OF “BACKWARD” VARIANT

The objective of this stage of the “backward” variant is to define the main theme of the STEAM project and to seek its possible connections with the thematic areas of the curriculum obtained in the common stage to the two variants. This stage consists of three phases:

PHASE 5. *General diagram*

In this phase, a general diagram of areas similar to the “forward” variant is generated, with five sectors, one for each discipline, but with only two concentric circles, showing the conceptual thematic areas on the outside and the non-conceptual, or procedural, on the inside, see Figure 3.

PHASE 6. *Choosing the STEAM project theme*

IIn this case, and unlike the “forward” variant, the theme does not come from an area of opportunity, but it can be taken from any theme generated by the teacher’s or student’s creativity.

For the STEAM project to be considered as a quality project, the main theme must meet the same characteristics as the opportunity area of the “forward” variant: it must stand out for its centrality and breadth, be close to the student and sufficiently connected with the thematic areas of the curriculum obtained in the first stage of the methodology.

PHASE 7. *Selection of the thematic areas of the project*

At this time, once the main theme of the project has been chosen, we go back to phase 5 and from the diagram we select the thematic areas that have, explicitly or implicitly, connections with the main theme and that will be part of the STEAM project.

In the same way as in the “forward” variant, for a STEAM project to be considered complete, it must contain thematic areas of each of the STEAM disciplines and, if possible, of all the procedural areas within the diagram.

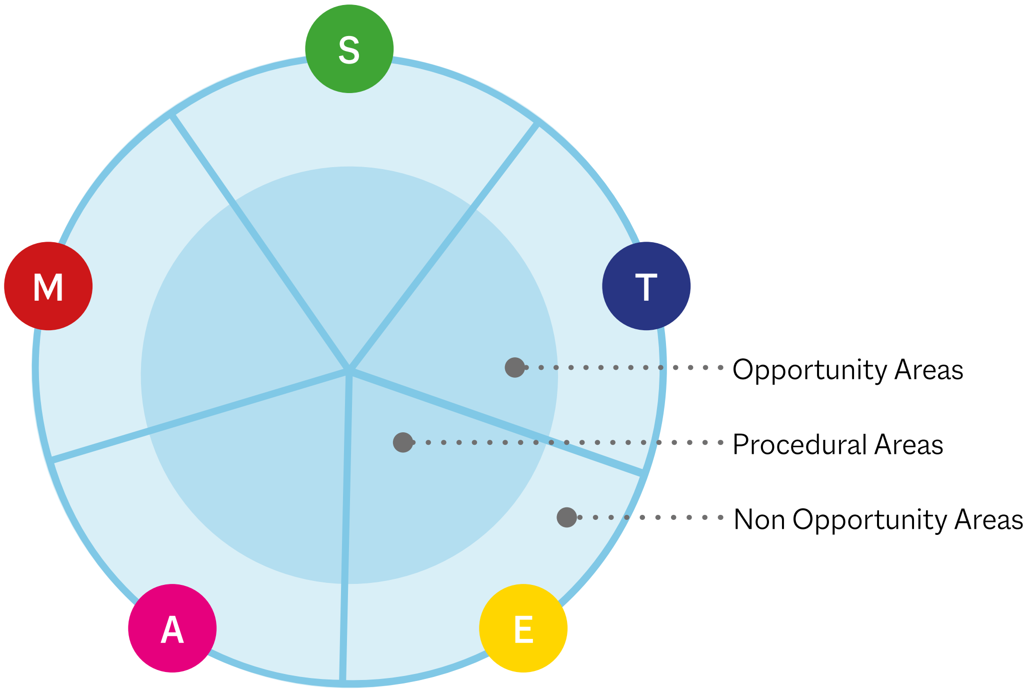

Figure 3. *General diagram of “backward” methodology*

EXAMPLE OF APPLICATION

The present example of application is developed based on the legal framework of the Spanish State, within the scope of the Valencian Community to which the competences regarding educational matters have been transferred and it has developed its own educational legislation based on that published at state level.

The example is based on the last educational law, Organic Law 8/2013 for the Improvement of Educational Quality (LOMCE, 2013), the curricular elements for Primary Education are underlined in Royal Decree 126/2014 (RD 126, 2014) and, in the case of the Valencian Community, the development of the curriculum for this stage has been completed in Decree 108/2014 (D 108, 2014).

The analysis of the curriculum is focused on the 4th, 5th and 6th year of Primary Education. During the phase 1, 1020 items were analysed. During the phase 1, the vertical redundancies were searched, that is, the items whose text is written exactly the same in several of the courses studied, the number of items being reduced to 644. Subsequently, in phase 2, the items with similar content were grouped into 281 “curricular groups”. Once the different curricular groups were established, the STEAM classification began, Phase 3. Of the 281 curricular groups detected in the four subjects, 218 were classified within the STEAM disciplines.

The fourth phase began by gathering the curricular groups of each STEAM discipline into thematic areas dealing with related topics. A total of 41 thematic areas were found, of which 30 develop conceptual contents and 11 develop procedural contents, see next table.

	S	T	E	A	M	TOTAL
Curricular groups by discipline	52	22	57	38	49	218
Thematic areas by discipline	10	4	10	6	11	41
Conceptual	9	1	7	4	9	30
Procedural	1	3	3	2	2	11

Table 1. *STEAM Classification*

The conceptual thematic areas that meet the necessary conditions to be the main topic of a STEAM learning project were called areas of opportunity. That is, an area of opportunity is a conceptual thematic area that has the characteristics of the challenge or challenging question of project-based learning and the characteristics of the generative topic of teaching for understanding (Yakman, 2008).

To determine the areas of opportunity, five maps were drawn with the connections between the thematic areas of each discipline and the conceptual thematic areas with the highest number of connections were selected as areas of opportunity. Two thematic areas are considered to be connected if an evident guiding principle can be found that allows them to be included within the same learning project.

Non - Conceptual	Conceptual	
	Opportunity Area	Non Opportunity Area
S1. Scientific research	S4. The cell and living beings	S2.The human body: structure and functions
	S5. Ecosystems	S3. Health and sickness
	S6. Sustainability	S7. Weather and climate
		S8. Hydrosphere: water
		S9.Llithosphere: relief
		S10. The solar system
		S11. Economic and human activity
T1. Use of ICT	T3. Electrical machines and appliances	T4. Calculator
T2. ICT property and security licenses		
	E1. Matter and materials	E2. Electricity and magnetism
	E4. Measurement: Units, Measurements, and Devices	E3. Scales, maps and representations
	E7. Geometric paths	E5. The measure of time
		E6. The monetary system
		E8. Forces: gravity, friction and velocity
		E9. Waves: light and sound
A4. Interest in artistic manifestations	A1. The image: elements, value and functions	A2. Advertising, social function and elaboration
	A5. Plastic and audiovisual composition	A3. Cinema and animated cinema
M1. Math problem solving	M5. Proportionality and percentages	M2. Natural numbers
M3. Operations with natural and mental calculation	M7. Plane figures: elements, perimeters and areas	M4. Fractions and Decimals
	M9. Statistics	M6. Angles and sexagesimal system
		M8. Geometric bodies
		M1. Probability

Table 2. *Shows the connection maps concerning the five disciplines where the 11 areas of opportunity identified are shaded: four in Science, one in Technology and two in Engineering, Art and Mathematics.*

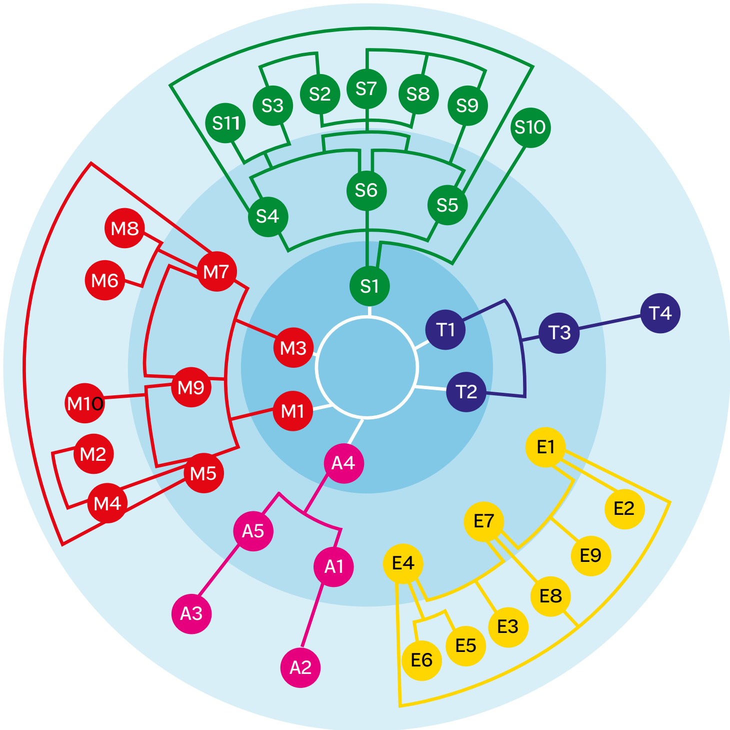

Figure 4. *General diagram*

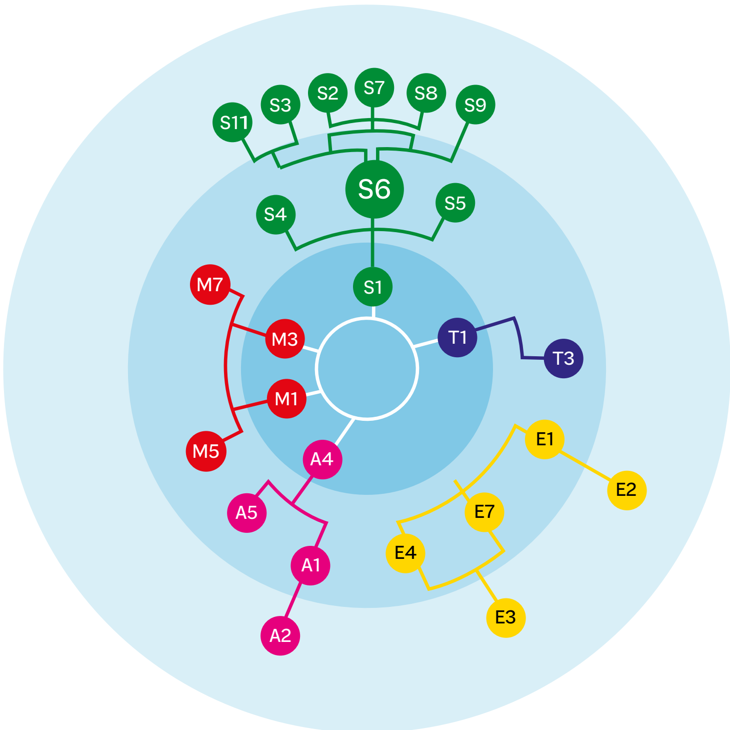

Figure 5. *Diagram for the "Sustainable city"*

If you want more information about the methodology, examples, etc, visit (Montés et al., 2023).

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5. PORTFOLIO OF DEVELOPED PROJECTS

Un sogno a Venezia_ARCHITECTURE

La storia del sale e dell_oro_STEAM COOKING

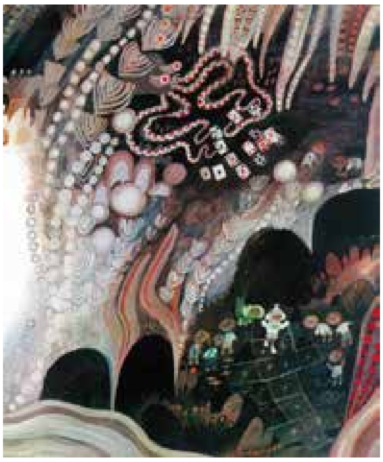
Nonno Tommaso_ICESCREAM

La città dei fiori_MAKE VISIBLE THE INVISIBLE

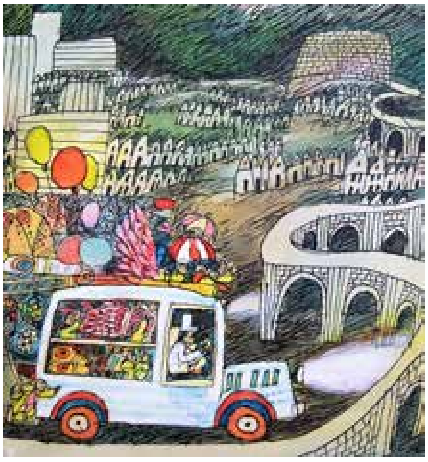
La nostra meravigliosa terra
AI FOR CREATIVE PEOPLE

Un sogno a Venezia
PRINTING THE CITIES OF THE FUTURE

Il sole ritrovato_SOLAR ROBOT



Un sogno a Venezia_MOVING PICTURES



Nonno Tommaso_ICESCREAM

STEAM COOKING

AGE: 11-16 years

MAXIMUM NUMBER OF STUDENTS: 20-50 teams (2 to 4 students)

DURATION: 6 months

SHORT PRESENTATION

The kitchen is a laboratory and cooking is an experimental science. When we cook we generally follow a recipe (either written or from memory); we select, quantify and process the ingredients and then serve the food to our friends, family or guests. A good cook (or scientist) will keep records in a notebook of exactly what they do so that they can repeat the experiment (recipe) as required.

The objective of STEAM COOKING is to connect, through a fun cooking contest, the skills and knowledge of science, technology, engineering, art and mathematics (STEAM) that secondary students study in class, connecting the concepts they are learning in class. with the experiences they carry out in the kitchen and during the cooking process.

IMPLEMENTATION

The STEAM Cooking project is defined as a competition in which students must overcome different challenges related to different topics. The phases of the competition will be as follows:

- **PHASE 1**

  Teams will register for the competition via the website (https://steamcocina.dart4city.eu/). In the registration they must provide a name of the team, which must be appropriate and pertinent to the theme of the Contest, and a video presentation of 1 to 3 minutes, arguing and defending their skills and motivation to participate in it.

- **PHASE 2**

  In this phase, participants will have access to different training materials, whether texts, videos, websites or applications, to learn about the 10 topics proposed.

  On each of these contents, a theoretical-practical activity will be proposed, which must be delivered in the format and place indicated for each of them (presentation, video, Padlet, mind map, infographic, etc.). Each topic and its corresponding activity are scheduled to take place in one week, although the final delivery deadline will be closed at the end of phase 1, for final evaluation and score distribution.

  At the end of this phase, a classification or ranking is generated with the awarded score in each topic.

- **PHASE 3**

  The teams will have 3 weeks to formalize their proposal in which they must define and argue a one-day menu, putting into practice the contents learned and complying with the instructions indicated on the website for this phase. The Jury will evaluate and score the proposals of phase 2, adding the points to those obtained in phase 1.

  The top 5 teams will move on to the final phase.

- **PHASE 4**

  The finalists classified for this phase will be summoned to a face-to-face session where they will present the project developed in phase 2 and will cook three dishes from their menu (main course, second course and dessert).

  The Jury will evaluate and taste the dishes presented and will award the corresponding points that will decide on the final classification. This score will be independent of that obtained in phases 1 and 2.

MAIN FORMATIVE GOALS

The STEAM cooking project is defined as a competition in which students must overcome different challenges related to different topics.

1. Arts: The concepts treated are logo creation, composition, color and texture and plating.

2. Marketing and publicity: The concepts treated are marketing and publicity, web page creation and storytelling.

3. Biology: The functioning of the human body and its biological needs. Nutritional breakdown of food. Eating and healthy diet. Botany, planting fast-growing foods, and home garden for own consumption.

4. Mathematics: Measurement units, proportions, mathematics and art, proportions, symmetry, geometry, etc, in the plating moment.

5. Economy: Economy for cooking. Business plan. Market analysis. Plans to make the company profitable.

6. Sustainability: Km0 products, recycling reuse. Renewable energy for cooking.

7. Chemistry: When we cook food, a myriad of different chemical processes simultaneously take place to transform the ingredients.

8. Physics: Thermodynamics, heating, freezing, electricity of the oven.

9. Technology: The technology of different devices that you could find in the kitchen are analyzed and connected with the subjects.

10. Design: Design sprint to propose new solutions to problems detected during cooking or in the kitchen.

MATERIALS / LINKS

For the management of the content, a web page was developed (https://steamcocina.dart4city.eu/), to manage the content. Teams can upload video presentation, check and revise the material of each topic and upload their results.

1. For every topic/week, a master class is also scheduled on the topic. The speakers of each master class are specialists in the topic, offering additional information to the material provided on the web. Masterclasses are saved and uploaded to the content account on Youtube channel (https://www.youtube.com/channel/UCG3LvyUZebB2mownnzRD4jQ). Also materials created by the teacher can be upload in the channel.

HOW TO EXPORT IT

Analyze the curriculum of your country and complete the first 4 common phases of the analysis. Once you have detected the thematic areas, connect them with the cooking activities that you want to promote. Remember, be creative, the activities that take place in the kitchen can connect with almost all thematic areas.

PROJECT DESIGN

The STEAM-Cooking project was designed by the CEU Group and then, designed originally for the Spanish curricula and for the secondary level.

The project was designed using "backward" methodology where 35 of the 40 thematic areas detected in the curriculum have been explicitly or implicitly addressed: 11 procedural areas and 24 conceptual areas; that is, 87.5 % of the thematic areas included in the entire curriculum.

METHOLOGY

The methodologies that are applied to the project are active methodologies, particularly project-based learning, cooperative learning and flipped classroom, which have been revealed as effective tools in STEAM projects.

In "Project-Based Learning": students design and make certain products throughout the project, such as designing their team logo, a healthy menu, etc.

In this project, the "Cooperative Learning" is also used, the students work as a team to solve the challenges and carry out the project.

The "Flipped classroom" methodology was also used when students learn content at home from the online masterclass by Teams and from the videos that were posted on the platform in which some challenges were explained.

In this type of methodologies, the teacher, to obtain the objectives, adapts the project to his students and acts throughout the entire project as a tutor, counsellor and guide for his students, so that they are able to generate their own knowledge

EVALUATION

The contents related with each subject is evaluated by the teacher of each one as a part of their subject.

The team present their results in a presentation where the jury are the teachers of the subject. One of the points evaluated are the ability of the students to connect the contents of the subjects with their proposal.

La storia del sale e dell_oro_STEAM COOKING

STEAM ARCHITECTURE

AGE: Recommended age 6-18 years
MAXIMUM NUMBER OF STUDENTS: 20-50 teams (2 to 4 students)
DURATION: 2 hours per week

SHORT PRESENTATION

STEAM architecture aims to connect the knowledge of the subjects of the different educational levels with architecture to promote greater knowledge about it among citizens.

The project reaches all educational levels, from kindergarten to high school. For each level, a level of abstraction is worked based on the perception that the student has of what surrounds him. In children, it focuses on their room, since they are not able to recognize beyond it. In elementary school at home, in secondary school he focuses on the neighborhood and in high school on the city, perceiving architecture in its entirety.

IMPLEMENTATION

The STEAM Cooking project is defined as a competition in which students must overcome different challenges related to different topics. The phases of the competition will be as follows:

- **PHASE 1_ *Room***
  Teachers for different subjects connect their contents with things related with the room. At the same time, some basic concepts of architecture are explained to conect the contents with the reality.

- **PHASE 2_ *House***
  Teachers for different subjects connect their subjects with things related with the house. At the same time, some architectural concepts are introduced to connect the contents with the real world.

- **PHASE 3_ *Neighbourhood***
  Teachers for different subjects connect their subjects with things related with the neighbourhood. At the same time, architectural concepts related with the neighbourhood are introduced to connect the subjects with architecture.

- **PHASE 4_ *City***
  Teachers for different subjects connect their subjects with things related with the neighbourhood. At the same time, architectural concepts related with the neighbourhood are introduced to connect the subjects with architecture.

METHODOLOGY

The methodologies that are applied to the project are active methodologies, particularly project-based learning, cooperative learning and flipped classroom, which have been revealed as effective tools in STEAM projects.

In “Project-Based Learning”: students design and make certain products throughout the project, such as designing their team logo, a healthy menu, etc
In this project, the “Cooperative Learning” is also used, the students work as a team to solve the challenges and carry out the project.

The “Flipped classroom” methodology was also used when students learn content at home from the online masterclass by Teams and from the videos that were posted on the platform in which some challenges were explained.

In this type of methodologies, the teacher, to obtain the objectives, adapts the project to his students and acts throughout the entire project as a tutor, counsellor and guide for his students, so that they are able to generate their own knowledge.

PROJECT DESIGN

The project was designed with the backwards methodology. This methodology allows the use of themes that can promote meaningful learning in the student. Prior to the design of the project, surveys were carried out on different social groups to demonstrate the need and importance that this project would have in society.

Next, different levels of approximation were carried out depending on the educational level, due to the perception that the student has of what surrounds him. For students between 4-6 years the room works, 7-11 the house, from 12 to 16 years the neighborhood and from 16-18 the city. At each educational level, the connection with the subjects of each level is sought.

Un sogno a Venezia_ARCHITECTURE

HOW TO EXPORT IT

Analyze the curriculum of your country and connect the room, house, neighbourhood and the city oportunity area related with the architecture with the contents of the subjects.

Once you have detected the thematic areas, connect them with the activities that you want to promote.

Remember, be creative, the activities that take place can connect with almost all thematic areas.

EVALUATION

The contents related with each subject is evaluated by the teacher of each one as a part of their subject.

The team present their results in a presentation where the jury are the teachers of the subject.

One of the points evaluated are the abiity of the students to connect the contents of the subjects with their proposal.

MATERIALS / LINKS

At the following link you will find:

- The complete presentation of the project
- Video and photos that document the experimentation carried out.

DIGGING THE PAST, TO (3D) PRINTING THE CITIES OF THE FUTURE

SHORT PRESENTATION

This STEAM project aims to promote the creation of a sustainable and environmentally friendly city, using 3D Printing. Participants are asked to list the problems that modern cities have, and to indicate how they affect the environment and the society in general, for example:

Pollution (car emissions), increase of temperature (reflection of heat out of metallic surfaces), noise pollution, high energy consumption, overpopulation, decrease of natural environments (parks, natural recreational areas) etc.

Finally, they suggest solutions and create the ideal sustainable city.

PROJECT DESIGN

The project was designed by the HERON (mathisis.org) team for implementation in the primary education.

The project was designed using the "forward" methodology where 35 of the 40 thematic areas detected in the curriculum have been explicitly or implicitly addressed: 5 procedural areas and conceptual areas; that is, 12.9\% of the thematic areas included in the entire curriculum.

The procedure is based on the Problem Based Learning methodology.

AGE: 10-12 years

MAXIMUM NUMBER OF STUDENTS: 25 students

DURATION: 6 months

HOW TO EXPORT IT

An analysis of the curriculum of Cyprus regarding History, Mathematics and Environmental Education was performed to identify the main phases for the analysis. The identification of the thematic areas allows the connection of the activities described in the following paragraphs. It is advisable that changes are made to adjust and adapt the scenario to each country and its unique history.

METHODOLOGY

- Project Based Learning
- Collaborative Learning

EVALUATION

- On going evaluation through observation
- Final evaluation of the outcomes

MATERIALS / LINKS

- Chirokoitia settlement: https://whc.unesco.org/en/list/848/
- Google Earth: shorturl.at/IC235
- Footprint:www.footprintcalculator.orghome/en
- 3D buildings video: shorturl.at/ilJL3
- https://www.tinkercad.com/

IMPLEMENTATION

The STEAM Cooking project is defined as a competition in which students must overcome different challenges related to different topics. The phases of the competition will be as follows:

- **PHASE 1_** *History / Human evolution - 90'*

  Pupils are introduced to a broader thematic of the history of Cyprus, this of the Neolithic Era viewing it from a broader spectrum, as a phase of parallel evolution of the humanity. Initially, the teacher will use various kinds of material (multimedia, texts, books, historical sites, presentations, questionnaires etc.), to provide all the information needed for the pupils to be able to explain the main context and information derived from the historical documents.

  At a later stage, the activity will focus on a certain place of the island of Cyprus, this of the Choirokoitia Neolithic Settlement (https://whc.unesco.org/en/list/848/). Through research, questioning, discussion, etc., pupils shall be able to determine the importance of this place, not only for Cyprus but the whole world, since it is protected by UNESCO. This is a rather theoretical stage, but it will prepare them for the next phase.

- **PHASE 2_** *Natural sciences / Geography / Mathematics / Technology- 90'+ 90'+ 30'*

  The class can be divided into groups of three or four pupils. Each group will be assigned to make a list of the decisions that our ancestors took to set up the settlement, according to a) the area and its surroundings, b) the material that this area had to offer and c) their everyday needs. This activity will be based on research and will enable pupils to conclude and explain how those people built their houses, how they took advantage of the landscape as well as of the material that nature offered in abundance, and how their everyday life would be like. This stage is a good opportunity for them to start making comparisons between then and nowadays.

  This activity will be followed by an on-site visit to the settlement, since it is very important to feel like real "archaeologists", trying to discover on their own all the elements that compose the value of this place. They will touch the buildings and stones, collect specimens, take pictures, measure the buildings, and overall take the vibes of the very place. Alternatively a virtual tour would be quite as much helpful, using Google Earth tool. In that case, measurements shall be presented as information by the teacher.

  To summit this phase pupils will prepare a list with the conclusions obtained during the previous activities and present it along with the material they gathered.

- **PHASE 3_** *Mathematics / Arts / Technology / Ecology - 60'+ 60'*

  At this phase pupils will get involved in activities that will allow them to model express the buildings in two different workshops. The first workshop aims at a 2D representation of the building on plain paper. The purpose is to sketch the top and front view of the ancient buildings. It is a rather easy to complete activity, but to get to a successful outcome they should use mathematical scale, based on their measurements, so that the houses have the correct proportions, providing a complete form of a 2D model. The second workshop aims at a 3D representation, using clay.

  Once the workshops are finished the teacher can use the questioning method, to prepare pupils for the next phase. For instance, they can ask, if we compare the buildings we live in and our lifestyle with that of the neolithic era, what is the degree of the ecological footprint in each case? Why? What can we do to reduce it? etc. They brainstorm and then they use an online test to verify their thoughts (https://www.footprintcalculator.org/home/en). In that case pupils are introduced in a new cycle of investigation that mostly promotes critical thinking. At the same time sustainability starts to emerge as a new topic.

PHASE 4_ *Mathematics / Arts / Technology / Ecology - 90'+ 30'+ 60'*

In this phase pupils are facing a real problem based on their everyday life, that of the environmental descending of modern cities, focusing on buildings, and they are asked to propose solutions. Now they will be asked to connect the context of the previous phases and use it to generate practical solutions. In groups they are asked to prepare a list or infographic or mind map with the problems that modern cities are facing. They need to propose a new way of building less energy consumable houses, using ecological material. The point is to combine the advantages of the two eras (nature and simplicity on one hand – technology and science on the other hand) and find a compromise, minimizing the exploitation of natural resources, without losing any comforts of modern life.

The next question is to decide what kind of ecological material will be used and how the building can be environmentally friendly and self-sustained in terms of energy. This is a very good point to introduce students into the idea of 3D printed houses. Short videos can be a very good mediums to get a comprehensive idea of this practice. This VIDEO is one of many that can be used as a prompt for discussion.

Now they will be asked to reconsider their previous 2D representation of the building on plain paper. The purpose is to sketch a 2nd version of the top and frond view of the buildings, combining the simplicity with the modern approach. They also need to emphasize on the aesthetics of the building.

PHASE 5_ *Arts / Technology - 60'+ 30'*

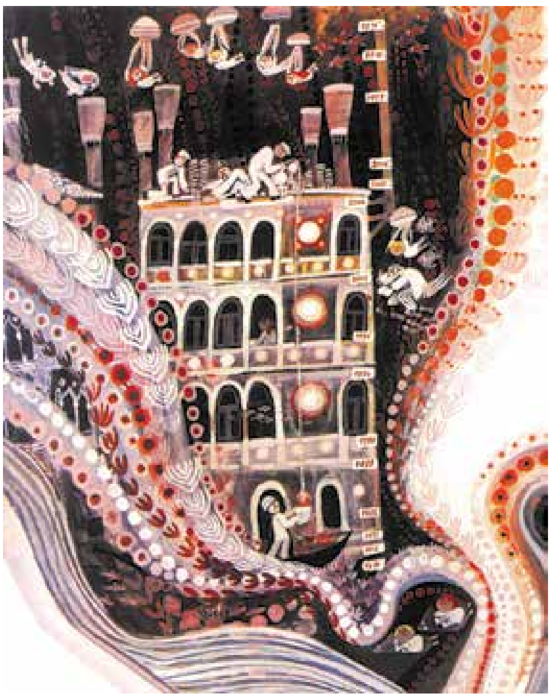
At this final stage, pupils will be asked to represent the outcome of the previous activity, using Tinkercad, a free web app for 3D design, electronics, and coding. Once the are done, the teacher can proceed to present a 3D printer, talk about its features and explain that they will get to print their 3D models to create a maquette of their ecological, sustainable and environmental-friendly city! The teacher will also show pupils how to use the application of the available printer, how to insert the filaments, and will also explain about file conversion, slicing, etc.

According to the number and the size of the models, as well as of the type of the 3D printer, the time needed for printing will vary.

PHASE 6_ *Arts / Technology - 60'+ 30'*

This is an additional activity that can be seen as an act of exhibition of the final outcome of the previous sequence of activities. Pupils can proceed to painting their models and create a complete town maquette, using other material as well, to impress their schoolmates.

Un sogno a Venezia
PRINTING THE CITIES OF THE FUTURE



SOLAR ROBOT

AGE: 11-12 years
MAXIMUM NUMBER OF STUDENTS: 25
DURATION: 6 Months x 80'

SHORT PRESENTATION

Students will study robots and robotic vehicles used today in various situations around the world, from simple entertainment or educational robots to terrestrial and/or space exploration robots. The focus will be on space exploration robots and robotic vehicles and the need to use solar power for continuous operation.

Thus, students will work on a robotic vehicle that will be powered by solar panels to create a completely autonomous machine by transforming a locally-developed robot (Engino Robotics Platform) to a solar one. This will require students to be creative, not only in the design of the actual vehicle but also in 3D printing various parts that will allow solar panels to be connected to the main body.

PROJECT DESIGN

The project was designed by the HERON (mathisis.org) team for implementation in primary education.

The project was designed using the backward variant of the proposed methodology by analysing the curriculum, filtering the items identified (vertical redundancy) and forming the curricular groups. In total, 82 thematic areas were detected in total, with 12 identified in the project, of which 9 procedural areas and 3 conceptual areas, for a percentage of 14.6% of thematic areas included in the curriculum.

HOW TO EXPORT IT

The local curriculum needs to be analysed in order to identify the 4 common phases (Phase 1 - Phase 4) of the methodology.

This will enable the content developer to choose the STEAM project theme for implementation, through a series of project thematic areas.

METHODOLOGY

For the project, a cross-curricular approach was followed, with collaboration between teachers of various subjects, as mentioned in Steps 1-6. Students worked in teams using the Jigsaw Collaborative Methodology, where every student has a particular role within the team.

The project followed a project-based learning approach since it had a single (main) goal, to develop a solar robot.

EVALUATION

The evaluation is based both on the learning aims of each subject (ie in Science, to be able to connect batteries in serial and parallel) and also based on the final product, that is a working, programmable, solar powered robot.

Evaluation will also take into consideration the quality of work within each team, for example how decisions where taken and how each member of each team was involved in the project.

IMPLEMENTATION

The STEAM Cooking project is defined as a competition in which students must overcome different challenges related to different topics. The phases of the competition will be as follows:

- **PHASE 1_** *(Robotic Vehicles) - Science (Space Exploration) - 80'*

  Students study various sources of information (Text book, wikipedia articles, NASA Robotic Vehicles android app "Spacecraft AR") to learn more about robots and their various uses for exploring space.

  Students categorize these vehicles based on their characteristics and uses (ie robots in assembly lines, robotic surface vehicles, robots for deep space exploration).

  They identify the main parts of robots used for ground space exploration that allow them to be used for months or years without human intervention.

  Students understand that such robots that are sent to faraway planets (like Mars) need to be powered constantly using renewable sources such as solar power.

  A good example is the Philae Lander that was sent with the Rosetta space probe to explore the comet 67P/Churyumov–Gerasimenko. Because of a failed hook, the lander was stranded on a part of the comet that could not receive sun light, therefore limiting its ability to recharge batteries (The amazing adventures of Rosetta and Philae - YouTube).

- **PHASE 2_** *(Control Boxes) - Design and Technology - 80'*

  Students work with various control boxes supplied by the Ministry of Education and purchased by the school. These include the analog "Egg Boxes" (one per group of 4 students), Arduino boards, Engino Robotic Platform board, as well as BBC Micro:bit. Even though students will experiment with the various control boxes, the focus will be the Engino control box. Engino is a local (Cyprus) product (Robotics ERP (engino.com). It consists of a control box that allows connection of various sensors and motors and can be programmed on a computer using a programming environment similar -but not based on- Scratch. Engino uses a brick-based system of parts to assemble almost any type of object, be it a house or a robot. Therefore, students will be able to develop their own robot based on their own designs.

  The Engino robot is powered by 6 1.5V AA batteries. However, only 3 are required for normal operation, since the added 3 are used to increase the autonomy of the robot. The connectivity of solar panels will be studied in science.

- **PHASE 3_** *(Connectivity of Electrical Circuits) - Science: Parallel and serial connection - 80'*

  Students study what happens to electrical circuits when:

  (a) two batteries are connected in serial
  (b) two batteries are connected in parallel
  (c) two lamps are connected in serial
  (d) two lamps are connected in parallel

  This will be important in order to decide the connectivity of the solar panels on the robot. Since the robot requires at least 3 AA 1.5V batteries, similar solar panels will be used. Students connect solar panels in serial and test them using a Volt-meter in direct sunlight to measure the voltage that is produced. If required, more solar panels can beconnected, since rarely we reach the ideal generation of power.

- **PHASE 4_** *(Renewable sources of energy) - Environmental Education - 40'*

  Students study the various sources of renewable energy (Solar, wind, geothermal, hydropower, ocean energy, bioenergy). They use their textbooks as well as online sources such as https://www.un.org to learn about the pros and cons of each type of source. They will suggest which type of renewable source will be more adequate for a robot and why (in space or on remote planets, the only viable source is solar).

- **PHASE 5_** *3D Design using Tinkercad) - Art: designing the 3D parts of the robot - 80'*

  Using Tinkercad, students are introduced to a 3D design environment (https://tinkercad.com). Tinkercad is a free, very easy to use 3D modelling environment that allows objects to be exported in various file formats that are compatible with 3D printers. Students learn how to use the "primitives" (basic objects) to create other, more complex objects. Since the "connectors" for the Engino parts are very complex, the basic connector part was provided by the manufacturer as a 3D model.

  Students measure the size of each solar panel and then are allowed to freely design the base on which solar panels will be attached, and in turn attach the final pieaces on the Engino-based robot. Students are allowed complete freedom on how to design their robot parts, including what colors to paint the final objects.

  Please note: the time it requires a 3D printer to actually print the objects is not calculated within the lesson duration, since this takes hours.

- **PHASE 6_** *Robot assembly & testing - Design & Technology - 40'*

  By this (final) stage, students will have developed and printed all the parts of the robot. The final assembly will be done in the Design & Technology Lab, and students will solder the wiring of the solar panels on the bottom (battery compartment) of the Engino control box. Testing will take place both inside the lab and outside in direct sunlight. Students will identify any and all issues of their robot and suggest improvements. Their robot will have to have at least two motors and at least one IR sensor.

Il sole ritrovato_SOLAR ROBOT

MOVING PICTURES

AGE: 9 years
MAXIMUM NUMBER OF STUDENTS: One class group
DURATION: At least 10 units of 2 hours

SHORT PRESENTATION

The activity proposes, through interdisciplinary teaching of STEAM subjects, a citizenship pathway on film and audiovisual language in order to develop awareness of the role of cinema and audiovisuals in contemporary culture.

Through this pathway pupils will be able to learn by doing (tinkering and robotics) and having fun, immersed in engaging activities.

The work analyses audiovisual language, its history, rules and functioning.

PROJECT DESIGN

The project has been designed for Dart4City by the teacher Cristina De Negri to be implemented in the fourth and fifth grade of primary school.

The design was made through the "backward variant" taking into account the General Guidelines (national curricula) for competences, where 34 thematic areas were identified and 17 areas of opportunity (procedural and conceptual) were embedded in the project.

The methods used were project-based learning, tinkering, cooperative learning and storytelling.

METHODOLOGY

- Project Based Learning (realisation of pre-cinema machines and a 'container site')
- Tinkering (we had moments dedicated to exploring materials and possibilities...)
- Cooperative Learning (we had time dedicated to cooperative work with assigned roles)
- Storytelling
- Educational robotics
- CLIL

HOW TO EXPORT IT

The analysis of the general framework for Italian curricula is wide enough to allow flexibility to adapt the project to several disciplines and curricula. An analysis of the different levels of learning and disciplinary content according to the national curricula (from step one to 4 of the overall Dart4City methodology) will allow the identification of the relevant thematic areas in other classes and countries.

The project requires collaboration among teachers and good command of both engaging pedagogical approaches and of technical requirements, such as use of robotics and the use of apps as well as a lot of creativity. The project can be broken down into simpler tasks according to the age of children and the group of teachers implementing it.

EVALUATION

The project is assessed as a reality task according to the following dimensions:

- Continuity
- Autonomy
- Participation
- Personal contribution
- Collaboration

MATERIALS / LINKS

At the following link you will find:

- The complete presentation of the project.
- Video and photos that document the didactic experimentation carried out.
- https://express.adobe.com/page/7laFhXPP28peG/

FORMATIVE GOALS

The project has been developed in 5 phases of exploration, learning by doing, scientific exploration, artistic research and final products. All phases entail the production of physical or digital products.

Main formative goals:

- Familiarise oneself with some forms of art and multimedia production by starting to use analog and digital tools.
- Become aware that film / audiovisual language is a language with its own rules and its own functioning.
- Identify the different codes and narrative sequences in film and audiovisual language.
- Learn about the history of animation and film through storytelling.
- Explore and operationally realise pre-cinema machines.
- Describe the functioning of the eye and optical illusions, also through CLIL activities.
- Know how to realise simple multimedia productions.

IMPLEMENTATION

- **PHASE 1_** *Exploration*

  The group visited the exhibition "Le immagini della Fantasia" in Sarmede (TV) and listened to some animated readings of entertaining illustrated books by the author Gerda Dendooven, guest of honour at the 39th edition: https://fondazionezavrel.it/le-immagini-della-fantasia-39/

  At school, in the same period, the group started reading the book "IL BAMBINO CHE AMAVA IL CINEMA" and discussing opinions on films, cartoons and their experiences as viewers.

  The teachers, at the start of the course, proposed an entry questionnaire on knowledge of audiovisual languages and their enjoyment, and expanded on vocabulary relating to the film world (also in English).

- **PHASE 2_** *Learning by doing*

  a) Carrying out research on pre-cinema machines.

  b) Make some pre-cinema machines to animate characters from the books illustrated by the author Gerda Dendooven, discovered during the exhibition visit.

  The pupils built:

  - A shadow puppet theatre, to project the monsters from the book 'The Story of Clever Krol and how he escaped death'.
  - A flipbook, a mutoscope with the image of a tree trunk: flicking through the pages quickly shows the leaves growing on the branches of the tree(the idea comes from the story 'The Tree Child').
  - A movie reel, which shows the tail of the piglet curling up (the piglet is the protagonist of the book 'All Pink').

- **PHASE 3_** *Scientific exploration*

  In order to understand the functioning of the eye and the persistence of vision, two pre-cinema machines were realised:

  - The thaumatropium, a kinetic medallion with two faces, one depicting a bird and the other a cage: as the medallion rotates quickly, our eye perceives the bird inside the cage.
  - The zootropium, consisting of a rotating cylinder with slits: looking at the series of frames through the slits, as the cylinder rotates quickly, the eye perceives the movement of the represented subject.

  To operate some of these machines, especially to realise the rotating movement of the movie reel and the zootrope, we made use of some programmable robotics kits (Lego Spike Essential, Sam Labs Maker Kit) using block programming language.

  Reflecting on the functioning of the pre-cinema machines, we proceeded with the study of how the eye works (CLIL) and the mechanism of the cinema projector.

  For this activity, the Mozaik application is useful with in-depth 3D studies dedicated to this topic.

PHASE 4_ *Renewable sources of energy - Environmental Education - 40'*

We read some short stories related to the cinema (it is possible to use other stories, depending on the time available):

- "La straordinaria invenzione di Hugo Cabret" in Italian.
- "The invention of Hugo Cabret, graphic novel in English.
- "I fratelli Lumiere e la straordinaria storia del cinema" in Italian.
- "Lights! Camera! Alice!" in English.

Through these materials we could start to research with pupils on the history of cinema, the people who work in it and the genres of film.

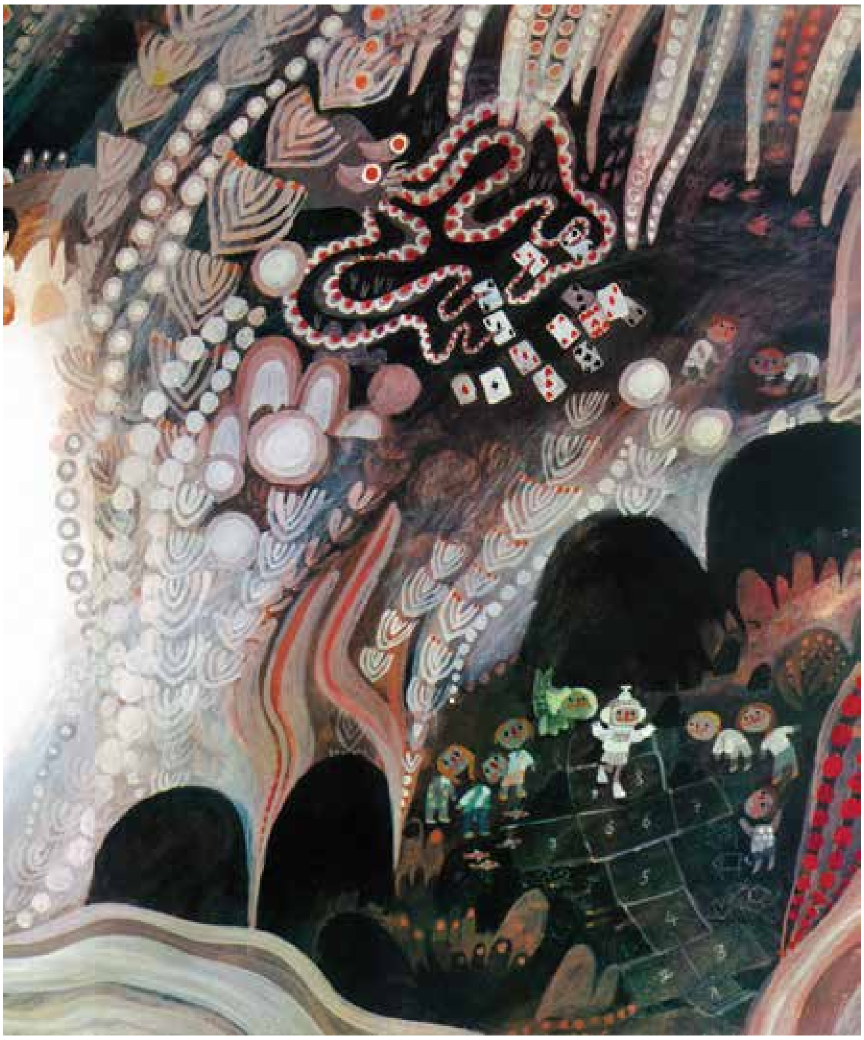
We also proposed the viewing of clips of films that are part of the history of cinema.

We studied in English the biography of an English director/actor, Charlie Chaplin.

PHASE 5_ *Final product*

With the use of some applications, we created short animations and presentations on the subject.

All materials are collected on a dedicated site created together with the pupils.



Un sogno a Venezia_MOVING PICTURES

ICECREAM (S)TEAM

AGE: 13 years
MAXIMUM NUMBER OF STUDENTS: One class group
DURATION: 16 - 20 hours

SHORT PRESENTATION

The project starts from one of the topics of civic education and it is related to the Agenda 2030 Sustainable Development goals, in particular Objective 12 "Responsible consumption".

It starts from reflection on daily consumption of something like icecream which is food that kids love.

It helps framing the issue of waste and recycling, reuse of food containers. It then moves on with the experimentation of creativity using modeling software, 3D printers and other 3D tools for presentation.

It includes skills related to public speaking and presentations as well as entrepreneurial spirit and civic sense.

FORMATIVE GOALS

Starting from a reflection on behaviour and lifestyle habits, the **Icecream S(TEAM)** project offers students the opportunity to experiment with their creativity by guiding them in reinventing everyday objects and gestures.

The project can be included in the Civic Education curriculum as a short module for an initial STEAM experiment.

It can contribute to increasing the wealth of concrete, lived experiences useful for guiding students in their learning choices.

Objectives and expected results

- Experiencing the process of creating a product.
- Experiencing 3D modelling.
- Evaluating the materials involved in terms of sustainability.
- Supporting responsible behaviour.
- Exercising creativity and inventiveness.
- Developing aesthetic and artistic sense.

Skills that can be activated

- Multilingual competence (acquisition of specific vocabulary).
- STEAM competence (connection between aesthetic and functional aspects of a product; practical application of disciplinary knowledge).
- Digital competence (3D modelling tools).
- Personal competence (depending on working approach).
- Citizenship competence (more responsible behaviour with regard to consumption).

Connections with thematic areas

- *History:* consumption over time; the industrial revolutions.
- *Art:* study of form; colours; design and communication.
- *Mathematics:* volumes, surfaces and their relationship.
- *Technology:* orthogonal projections; realisation of a project to scale; 3D
- modelling.
- *English and/or third language:* communication materials (packaging, labels).
- *Science:* sugar, nutritional content.
- *Civic Education:* Agenda 2030; conscious consumption.

EVALUATION

Ex ante evaluation:

- Motivation
- Expectations

Ex-post evaluation:

- Rubrics
- Product and project evaluation

Evaluation areas:

- Student learning
- Performance through the activities
- Use of questionnaires and reflection

HOW TO EXPORT IT

Starting from the analysis of the national curricula the project can be exported and adapted for other classes and ages, as it includes several disciplines and learning objectives.

An analysis of the different levels of learning and disciplinary content according to the national curricula (from step one to 4 of the overall Dart4City methodology) will allow the identification of the relevant thematic areas in other classes and countries.

The project can be adapted to other topics of responsible consumption, using everyday objects and tools. It can be used as a start of a longer project on the topic, and can be adapted to include different STEAM disciplines such as foreign language, history and arts. The project can be broken down into simpler tasks according to the age of children and the group of teachers implementing it.

IMPLEMENTATION

- **PHASE 1_ *Exploration***

  The objective is to stimulate students' critical thinking and creativity and make them reflect on the social and economic context in which they are immersed in order to imagine alternative development paths.

  The focus of this module will be on the following themes:

  - Sustainability, consumption, basics of design, aesthetics and functionality of everyday products, healthy lifestyles, nutrition.
  - How: teachers and external experts address the topics in class, with possible ad hoc interventions (1 hour) by external experts and homework (e.g. consumption check-list at home).

- **PHASE 2_ *Operational phase***

  Managed by the teacher with greater technological skills for design, technical drawing, use of SketchUp and 3D printing also in collaboration with external experts (1-2 hours).

  Working groups for use of technological tools. Each group becomes a small start-up and together with the teacher and external expert designs the prototype.

- **PHASE 3_ *Feedback phase***

  - Presentation of prototypes made with the 3D printer.
  - Marketing of the solution - groups present the work done .
  - Peer evaluation.

- **PHASE 4_ *Optional phase***

  After the work done at school, the challenge is presented in three to four schools - presentation of the solutions at a joint event - award ceremony between peers and external experts.

PROJECT DESIGN

The project was designed by a team of teachers during the workshops organized by Alterevo with the participation of four primary and lower secondary schools.

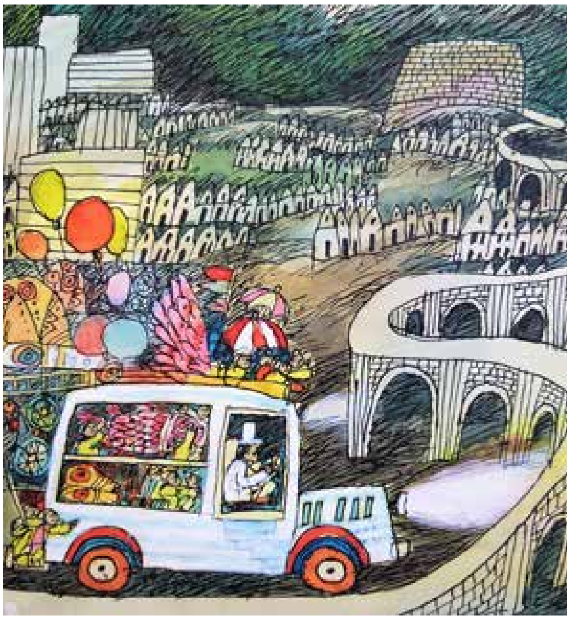
The design was made through the "backward variant" taking into account the General Guidelines (national curricula) for competences of middle school and the cross-cutting Civic Education guidelines which focus on digital, sustainable skills among others.

Of the 34 thematic areas identified in the national curricula, 11 opportunity areas (both procedural and conceptual) were embedded in the project. The project uses pedagogical approaches such as Challenge based learning and Problem-solving.

METHODOLOGY

- Challenge based learning
- Project-based learning
- Problem-solving

The project structure makes it easier to customise teaching and to divide and simplify the required tasks.



Nonno Tommaso_ICESCREAM

MAKE VISIBLE THE INVISIBLE

AGE: 8 years

MAXIMUM NUMBER OF STUDENTS: 25

DURATION: At least 6 sessions 2 hour per session

SHORT PRESENTATION AND MAIN FORMATIVE GOALS

Each one of us has a special place, real or imaginary, in which we feel peaceful, protected and free.

The aim of the project is to invite pupils to explore this place in order to create an artwork able to suggest this 'feeling at home' to others. To realize the artworks the suggested idea is to work around the syntax of the artwork itself so that the installation can change in time, as our feelings, and can express different nuances of the relation between us and the special place we choose to represent.

At the end, all artworks can be shown in an exhibition and/or in a virtual gallery.

Main formative goals:

- Being aware of the relationships field in which we are continuously immersed and made up of ourselves, others and the environment.
- Getting involved in the exploration of your own feelings in order to improve the understanding of yourself and your expressive abilities using artists from the past or present as inspiration.
- Begin to use analogical and digital conceptual and operational tools to recognize, investigate or express relationships both from a scientific-mathematical and personal-artistic point of view.

METHODOLOGY

- Project Based Learning
  We will realize an exhibition of our artworks.
- Challenge Based Learning
  In order to realize the project we have several challenges to complete.
- Tinkering
  We will have moments dedicated to explore materials and possibilities...
- Cooperative Learning
  In the third challenge we will be organized in groups and inside each groups there will be defined roles.

EVALUATION

A rubric that will help to evaluate/auto-evaluate the following dimensions:

- Collect
- Classify
- Semantic exploration
- Artwork
- Collaboration
- Respect of the materials

MATERIALS / LINKS

At the following link you will find:

- The complete presentation of the project.
- Video and photos that document the didactic experimentation carried out.
- In-depth links.

IMPLEMENTATION

- PHASE 1_ *Collect*

  Which place, in your environment, is the place where you feel peaceful, protected and free? Collect images, objects, sounds, perfumes, words, feelings, emotions, textures... that makes this place special for you. Try to capture why you're feeling 'home'.

- PHASE 2_ *Catalog/classify*

  Classify your collections: which criteria would you use?

- PHASE 3_ *Challenge 1. Exploration*

  Create the semantic field of your collection and realize a kind of dictionary/map.

- PHASE 4_ *Challenge 2. Figuration*

  Make visible the invisible: create your own artwork. Some that express your idea/feeling of what is 'feeling at home'.

- PHASE 5_ *Challenge 3. The museum - (collaborative)*

  Design and realize an exhibition with all your artwork,

La città dei fiori
MAKE VISIBLE THE INVISIBLE

ALL FOR CREATIVE PEOPLE

AGE: 11
MAXIMUM NUMBER OF STUDENTS: 25
DURATION: Variable, from a minimum of 8h to an entire school year

SHORT PRESENTATION AND MAIN FORMATIVE GOALS

Our proposal could be divided into two main steps:

- Investigate the past, the present and the near future having as main POV the relation between Technology and Arts.
- Focus on the topic of AI and, at the same time, realize some characters that can be used to create an interactive experience as explained after.

The two steps can be developed in the same school year or in two different moments. If you want you can also choose only one step.

Our proposal is to invite schools to take a journey until the contemporary suggestions in order to:

- Discover how AI are used in the art fields, from literature to cinema to the preservation of the cultural heritage.
- Invent some characters with a creative suggested process centered on the psychic process known as pareidolia.
- Use creativity, AI and tech competencies to animate characters that can be part of an interactive experience such as a game or a story.
- Learn the basics know how of AI and Big Data: from using pre-trained models to training their own model.
- Begin to recognize, understand and discuss the use of AI in our daily life

METHODOLOGY

- **Project Based Learning**
  We will realize an interactive experience using tinkering, coding and AI.
- **Challenge Based Learning**
  In order to realize the project we have several challenges to complete.
- **Tinkering**
  To invent the characters.

MATERIALS / LINKS

At the following link you will find:

- The complete presentation of the project.
- Video and photos that document the didactic experimentation carried out.
- In-depth links.

EVALUATION

A rubric that will help to evaluate/auto-evaluate the following dimensions:

- Artwork
- Collaboration
- Respect of the materials

IMPLEMENTATION

- **PHASE 1**
  Invent some characters with recycled and/or natural material.
- **PHASE 2**
  Take some pictures of your characters in several poses
- **PHASE 3**
  Prepare the pictures to be imported then Import characters and backgrounds in the coding platform.
- **PHASE 4**
  Program your interactive experience (a game, a story, an exercise...)

La nostra meravigliosa terra
AI FOR CREATIVE PEOPLE

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